Current Background Noise Sources and Levels in the NASA Ames 40- by 80-Foot Wind Tunnel - A Status Report

Christopher S. Allen
Stephen Jaeger†
and
Paul Soderman

NASA Ames Research Center
Moffett Field, California

Abstract for 6th AIAA/CEAS Aeroacoustics Conference

Background noise measurements were made of the acoustic environment in the National Full-Scale Aerodynamics Complex 40- by 80-Foot Wind Tunnel (40x80) at NASA Ames Research Center. The measurements were acquired subsequent to the 40x80 Aeroacoustic Modernization Project, which was undertaken to improve the anechoic characteristics of the 40x80's closed test section as well as reduce the levels of background noise in the facility. The resulting 40x80 anechoic environment was described by Soderman et. al.,[1] and the current paper describes the resulting 40x80 background noise, discusses the sources of the noise, and draws comparisons to previous 40x80 background noise levels measurements.

At low wind speeds or low frequencies, the 40x80 background noise is dominated by the fan drive system. To obtain the lowest fan drive noise for a given tunnel condition, it is possible in the 40x80 to reduce the fans' rotational speed and adjust the fans' blade pitch, as described by Schmidtz et. al.[2] This idea is not new, but has now been operationally implemented with modifications for increased power at low rotational speeds.

At low to mid-frequencies and at higher wind speeds, the dominant noise mechanism was thought to be caused by the surface interface of the previous test section floor acoustic lining. In order to reduce this noise mechanism, the new test section floor lining was designed to resist the pumping of flow in and out of the space between the grating slats

† Aerospace Computing Inc.

required to support heavy equipment. In addition, the lining/flow interface over the entire test section was designed to be smoother and quieter than the previous design.

At high wind speeds or high frequencies, the dominant source of background noise in the 40x80 is believed to be caused by the response of the in-flow microphone probes (required by the nature of the closed test section) to the fluctuations in the freestream flow.[3] The resulting background noise levels are also different for probes of various diameters and types. The inflow microphone support strut is also a source of background noise but this source's impact may be minimized by careful design of the strut.

In the present paper, the mechanisms mentioned above are discussed in detail. Their frequency and velocity ranges of dominance are defined and the differences between past and current facility background noise levels are presented.

This paper gives valuable information for those wishing to make acoustic measurements in the 40x80. With this report and an estimate of the noise levels produced by the noise source of interest, it should be possible to determine the signal-to-noise ratios and measurement locations to successfully perform aeroacoustic testing in the NASA Ames Research Center's 40- by 80-Foot Wind Tunnel.

References

1. Soderman, P. T, Jaeger, S. M., Hayes, J. A., and Allen, C. S., "Acoustic Performance of the 40- by 80-Foot Wind Tunnel Test Section Deep Acoustic Lining," proposed for the 6th AIAA/CEAS Aeroacoustics Conference, 2000.

2. Schmitz, F. H., Allmen, J. R., and Soderman, P. T., "Modification of the Ames 40- by 80-Foot Wind Tunnel for Component Acoustic Testing for the Second Generation Supersonic Transport," 7th European Aerospace Conference, AIAA, 1994.

3. Allen, C. S., and Soderman, P. T., "Effect of Freestream Turbulence on the Flow-Induced Background Noise of In-Flow Microphones," 4th AIAA/CEAS Aeroacoustics Conference, AIAA/CEAS-98-2297, 1998.

Author Information:

Christopher S. Allen
Aerospace Engineer
NASA Ames Research Center
MS 247-2 Moffett Field, California, 94035
(650)604-0074
(650)604-3489 fax
callen@mail.arc.nasa.gov
Senior Member AIAA

Stephen M. Jaeger
Senior Research Engineer
Aerospace Computing Inc.
NASA Ames Research Center
MS 247-2 Moffett Field, California, 94035
(650)604-1472
(650)604-3489 fax
sjaeger@mail.arc.nasa.gov
Senior Member AIAA

Paul T. Soderman
Aeroacoustics Group Leader
NASA Ames Research Center
MS 247-2 Moffett Field, California, 94035
(650)604-6675
(650)604-3489 fax
psoderman@mail.arc.nasa.gov
Associate Fellow AIAA